

Commercial Space Transportation Advisory Committee (COMSTAC)



Spring 2022 | Day 1 • PM

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**Welcome
James Hatt, FAA/AST**

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COMSTAC Introductions

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**Secretary Pete Buttigieg,
Department of Transportation**

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**Acting Administrator Billy Nolen,
Federal Aviation Administration**

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**Acting Administrator
Kelvin Coleman, Commercial
Space Transportation**

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Break

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**Diane Howard, Director of
Commercial Space Policy,
National Space Council**

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**Complete Enough Determinations &
Planned License Evaluation Process
Changes for Part 450**

**Michelle Murray, Manager, Safety
Authorization Division, Commercial
Space Transportation**

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Complete Enough Determination & AST Internal Process Changes

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Background

- COMSTAC recommended AST develop guidance for Complete Enough (CE) Determinations
 - The resulting guidance is a comprehensive list of criteria to provide more clarity on what is required for FAA to accept an application
- **The *Part 450 Guidance for Complete Application*** document will be used in conjunction with AST's internal license evaluation process to promote efficiency, order, and clear communication of application status with industry
- Concurrently, AST is developing a new **Phased Licensing Approach** for the internal license evaluation process to improve transparency with industry and overhaul our evaluation process
 - Provides broad guidelines for AST staff in the project management of each licensing evaluation, as well as consistent objectives within specific points in time
 - Provides set milestones for more predictable opportunities for feedback and evaluation status



The Underlying Need for CE Process Change



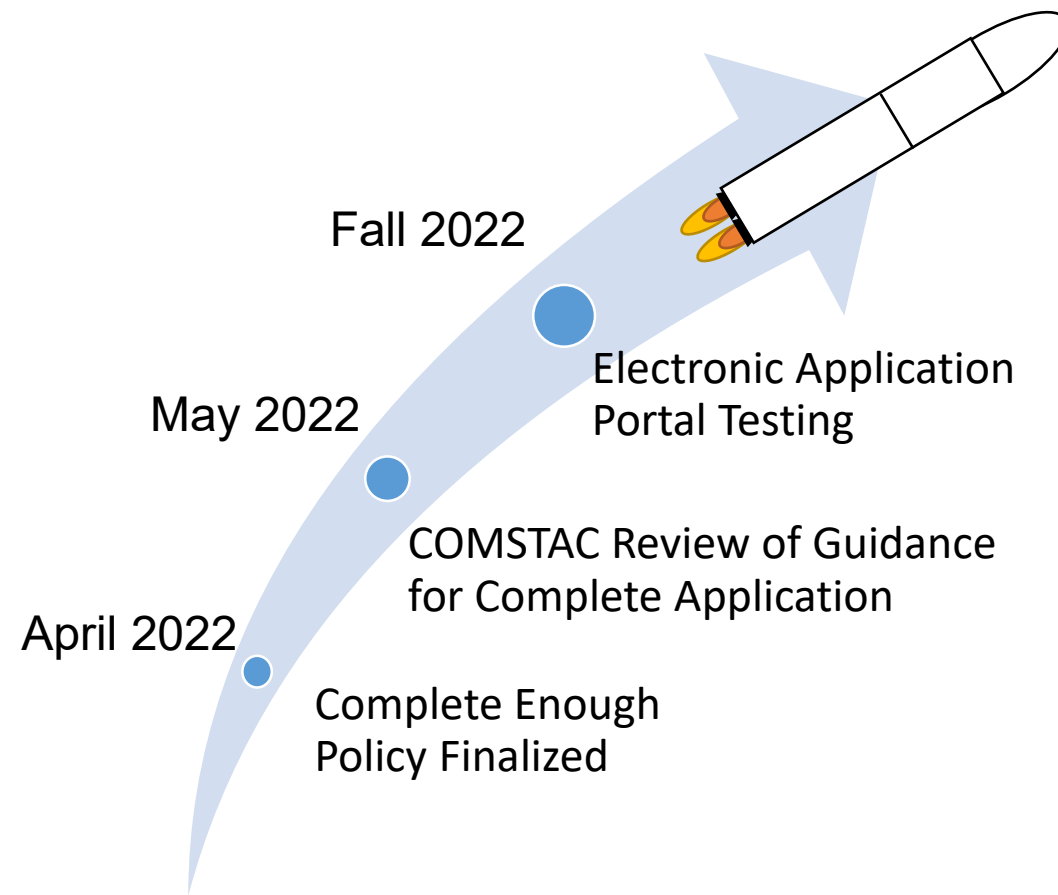
	Existing Challenges	Effects of Process Improvements
Relevant to Applicants	<ul style="list-style-type: none">• Requirements for CE Determination were not completely objective• The CE process did not have published criteria for acceptance	<ul style="list-style-type: none">• All subjectivity has been eliminated from the CE determination process• Clearer expectations for application acceptance process & determination• More consistent timeframes for CE Determination
Relevant to AST	<ul style="list-style-type: none">• AST's internal CE processes were not completely objective, making it difficult to improve efficiency and train new staff• The staff resources required for CE determination were significant due to the resources required to assess whether an application was complete enough	<ul style="list-style-type: none">• Reduced staff resource requirements for initial discussions & application acceptance• Downstream improvements in staff resource availability for other evaluations• Simplified staff training requirements for CE Determination• Allows for future automation of CE



Complete Enough Determination - Implementation



- AST is implementing a completely objective Complete Enough determination process
- Prospective Applicants will be able to utilize the guidance to inform the compilation of their license application
- All applications will be accepted provided there is a response for all of the components necessary to initiate the first phase of the Phased License Evaluation process
- During the application review period, the FAA will make determinations at each of the four phases on whether it can continue with its evaluation
- AST staff will utilize the guidance as a standard to judge all part 450 applications
- The guidance will be used in the development of the Electronic Application Portal to enable a more efficient and automated application acceptance process



Guidance for a Complete Application

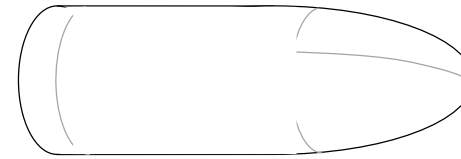
– Applicant Overview

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- AST is developing guidance that will clarify the specific criteria for each application requirement needed for application acceptance
 - The specific items necessary for a complete enough determination will be clearly identified
- The specific items necessary for AST to continue its evaluation at each phase of the review period will also be clearly identified
- This guidance should give applicants the ability to effectively organize the submittal of necessary licensing materials without delaying the overall evaluation



The New Part 450 Applicant Experience



Applicants will see enhanced **transparency**:

- At each phase, applicants will be provided with timelines for the evaluation of specific regulatory sections
- In order to avoid tolling and rejections, there will be clarity on when outstanding items are due
- Feedback on application status will be provided at dedicated milestones during the evaluation process

Applicants will experience greater **consistency**:

- AST will make initial determinations on tolling and rejections for applications that demonstrate substandard quality within two weeks of acceptance
- Applicants that propose significant changes to the vehicle or their hazard control strategy during the evaluation will need to restart the process

Applicants will benefit from higher **efficiency**:

- Evaluations for most applicants will be completed within 120 days
 - Applicants with novel concepts that pose significant regulatory challenges may take up to 180 days
- The number of technical interchanges will be limited to items that require a high level of discussion, such as novel concepts that are safety critical in nature



Guidance for Current & Future Applicants

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Going Forward, Applicants Must:

- Continue to make good-faith efforts to produce good quality applications that demonstrate regulatory compliance to a high degree of legal and technical sufficiency
- Continue to utilize the pre-application to plan regulatory compliance
 - Part 450 requires means of compliance in § 450.35(a) be accepted (approved) by the FAA prior to application acceptance (complete enough)
- Ensure the design of their vehicle and operations are mature prior to submitting an application
- Operators must also take into account the established 180 day evaluation timelines when scheduling proposed or anticipated operations



Complete Enough Determination & Phased Approach



Process Development Overview

- CE Determinations fall into the broader Phased Approach to AST's License Evaluation Process for Part 450
- CE Determination Process Summary
 - Defined required documentation necessary for a Complete Enough determination for a Part 450 application
- Phased Licensing Approach Summary
 - Defined key milestones, deliverables, and timeframes for the completion of each Phase



Guidance for Complete Application (Sample)



Guidance for Complete Application

2022 Apr 13

Hazard Control Strategies

Section	Narrative	Objective criteria for complete enough determination	Timeframe
450.108 Flight abort.	Development of flight safety limits, which is most of this section, is performed in concert with the flight safety analysis. See the introduction to Flight Safety Analysis in this document for more discussion.	<p>108(f)(1) Flight abort methods Does the flight abort methodology reference an accepted means of compliance?</p> <p>108(f)(2) Evaluation methods & data Is there a description of how each flight safety limit is evaluated during flight? Is there a description of how each flight abort rule is evaluated during flight? Is there representative quantitative data for each flight safety limit? Is there representative quantitative data for each flight abort rule? Is there list of critical parameters? Is each critical parameter described? Is there a description for how values of critical parameters were determined? Is there representative quantitative data for each critical parameter?</p> <p>108(f)(3) Graphical depictions Is there a graphical depiction of each flight safety limit? Does each graphical depiction include the nominal trajectory? Does each graphical depiction include the extents of normal flight? Does each graphical include limits of a useful mission trajectories? Does each graphic description that is a map include uncontrolled area boundaries?</p> <p>108(f)(4) Available data Is there a description of vehicle data available to evaluate flight abort rules?</p>	Phase 2
450.110 Physical containment.	Physical containment is a hazard control strategy described in § 450.110. The focus in pre-app is on the methods used to demonstrate that the launch vehicle does not have sufficient energy for any hazards associated with its flight to reach outside the flight hazard area. AST reviews the proposed means of compliance in pre-app to confirm that the methodologies will result in compliance with the regulation. Per § 450.45(b), services provided by a Federal site/entity by contract that has an FAA accepted approach is an accepted means of compliance.	<p>§ 450.110(c)(1) – Extent of hazard Is the method for determining maximum range of the vehicle discussed? Is the size of the hazard area around an impact discussed?</p> <p>§ 450.110(c)(2) – Clearance Are the methods for clearing flight hazard areas of the public documented? Is the potential for critical assets within the flight hazard areas discussed?</p>	Phase 2

- Key Components of *Guidance for Complete Application*
- Narrative
 - Description of the specified Part 450 section and its context within the licensing process
- Objective Criteria for Determination
 - Primary components and documentation within an application required for a positive CE Determination
- Timeframe
 - Licensing Phase during which the finalized deliverable will be completed and/or approved by AST



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Questions & Discussion

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**Part 450 Update: Usage, Lessons
Learned, and Benefits Gleaned So Far**
**Randy Repcheck, Deputy Director,
Office of Strategic Management,
Commercial Space Transportation**

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Outline



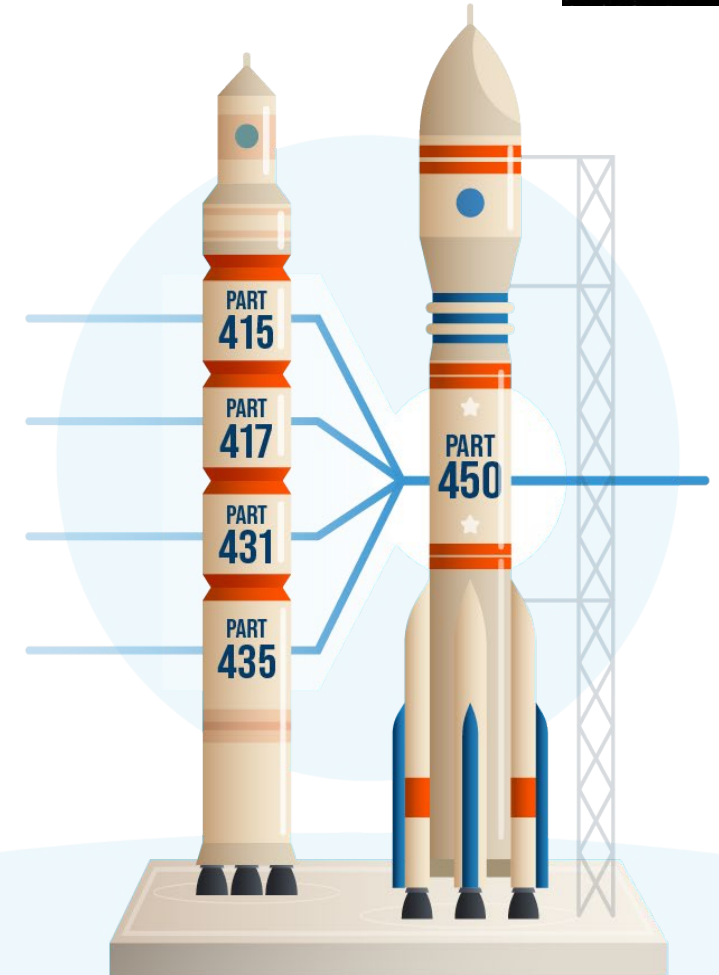
- Current Activity
- Early Benefits
- Early Challenges
- Advisory Circulars
- Way Forward



Current Activity



- Part 450 became effective on March 21, 2021
- Current Part 450 licensing efforts:
 - 1 active license
 - 4 active application evaluations
 - 8 projects in pre-application consultation
- FAA issued 10 ACs last year



Early Benefits



- Comprehensively captures safety issues
- Reduced scope of “launch”
- Ground safety at Federal launch ranges
- The use of Conditional Expected Casualty (CE_c)
- The implementation of separate risk criteria for Neighboring Operations Personnel
- Updated collision avoidance analysis



Early Challenges



- **Learning curve for FAA and industry.**
- **Performance-based rule**
 - Provides flexibility, but
 - Challenge to provide clarity and to maintain consistency.
- **Areas needing additional clarity:**
 - Data flows to and from Federal Launch Range
 - Focus on Methodologies
 - Incremental Review
 - System Safety
 - Levels of Rigor
 - Safety Critical Systems
 - Software Safety
 - Transitioning from Part 431 or 415/417 to Part 450
 - Unique Means of Compliance



Advisory Circulars



- **Ten Advisory Circulars issued from May – September 2021:**

- AC 450.101-1A High Consequence Event Protection
- AC 450.103-1 Safety System Program
- AC 450.107-1 Hazard Control Strategies
- AC 450.108-1 Flight Abort Rule Development
- AC 450.109-1 Flight Hazard Analysis
- AC 450.115-1A High Fidelity Flight Safety Analysis
- AC 450.117-1 Trajectory Analysis for Normal Flight
- AC 450.141-1A Computing Systems and Software
- AC 450.173-1 Part 450 Mishap Plan – Reporting, Response, & Investigation Rqmts.
- AC 450.179-1 Ground Safety



Advisory Circulars (cont.)



- **Eight currently planned for this fiscal year:**
 - AC 450.3-1 Scope of License
 - AC 450.161-1 Control of Hazard Areas
 - AC 450.167-1 Tracking
 - AC 450-119-1 Malfunction Trajectory Analysis
 - AC 450.110-1 Physical Containment as a Hazard Control Strategy
 - AC 450.31-1 Applying for FAA Determination on Policy or Payload Reviews
 - AC 450.123-1 Population Exposure
 - AC 450.169-1 Collision Avoidance Analysis



Advisory Circulars (cont.)



- **At least eight additional planned after this fiscal year:**

- AC 450.139-1 Toxic Hazards Analysis and Thresholds
- AC 413.5-1 Pre-Application Process
- AC 450.133-1 Airspace and Waterborne Vessel Hazard Areas
- AC 450.131-1 Probability of Failure
- AC 450.137-1 Distance Focusing Overpressure Risk Analysis
- AC (TBD) Hybrid Launch Systems
- AC 450.143-1 Safety Critical Systems
- AC 450.113-1 Flight Safety Analysis: Levels of Rigor



Way Forward



- Continuing to develop Advisory Circulars.
- Tracking lessons learned.
- Developing application portal to improve the application submission and evaluation process.
- Continue to work with the Federal launch ranges to improve efficiency and establish baseline timelines for input and output data flows.



Way Forward (cont.)



- Continue to work with industry to understand the issues it sees with Part 450 and suggested solutions.
- **Workshops**
 - Plan to conduct an industry workshop in June on system safety.
 - Discuss lessons learned to provide better understanding of what is needed to comply with the part 450 system safety regulatory requirements.
 - Will conduct additional workshops on other issues.



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Questions?



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**LOX Methane
(Liquid Oxygen/Methane)
Randy Repcheck, Deputy Director,
Office of Strategic Management,
Commercial Space Transportation**

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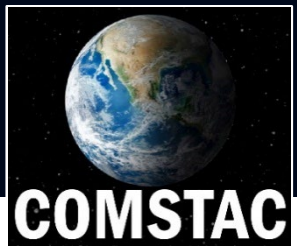
Outline



- Background
- FAA LOX/LCH4 Test Effort



Background



- Five launch vehicles currently under development use liquid oxygen and methane (LOX/LCH₄) propellants.
- Established formulas for LOX/LCH₄ propellant net explosive weight and associated modeling capability do not exist.
- Significant uncertainty in explosive yield for intact launch vehicle impact -
 - vs total mass
 - vs. impact speed



Background (cont.)



- DOD funded LOX/LCH4 “COMET” explosive test series for pre-flight scenarios in 2020.
 - More energetic than expected.
 - Unique characteristics – LOX/LCH4 combination is fully miscible.
- DOD/NASA Joint Agency Steering Group (JASG) planning long term test series for data to support (pre-flight) explosive siting.
 - Using lessons learned from COMET.
 - JASG results will not address launch vehicle intact impact.



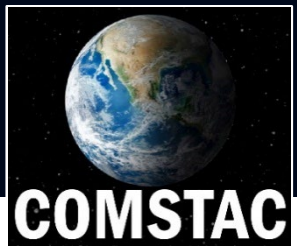
Background (cont.)



- New Common Standards Working Group (CSWG) LOX/CH₄ subgroup formed in mid 2021.
 - DOD, FAA, NASA
- Will define a common roadmap for the development of a common safety standard for LOX/Methane explosions.
 - Consensus approach to obtaining necessary impact yield information.
 - Recommended test architecture.
 - Test standards
 - Test article scaling, data collection, test calibration, and instrumentation.



FAA LOX LCH4 Test Effort



- FAA is only CSWG member that has currently planned and funded intact impact testing to date.
- FAA has contracted with Bangham Engineering to conduct initial intact impact testing.
- Two phases:
 - Phase 1: Tests of constant impact velocity with varying mass
 - Phase 2: Tests of constant mass with varying impact velocity



FAA LOX LCH4 Test Effort (cont.)



- FAA will share intact impact test results with U.S. Government agencies and with industry.
 - Whole of government/industry problem – requires non-proprietary data.



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Questions?



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**Public, Private, and International
Cooperation in the Responsible Use
of Outer Space**

**Valda Vikmanis-Keller, Director, Office of
Space Affairs, Department of State**

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A photograph of the Earth's horizon from space, showing a curved blue planet with white clouds against a black background. A bright light source, likely the sun, is visible on the horizon line, creating a lens flare effect.

COMSTAC Reflections

2020-2022

Two Years of Giant Leaps for the U.S. Commercial Space Transportation Industry

- The return of crewed launch to the ISS from the United States
- Era of Space Tourism kicked off
- Large constellation deployment in earnest
- Enabling exploration
- Enabling critical services
- A booming launch industry
- Putting spaceports on the map
- Applying launch innovation to addressing the global pandemic
- Resilience of the industry during a global pandemic

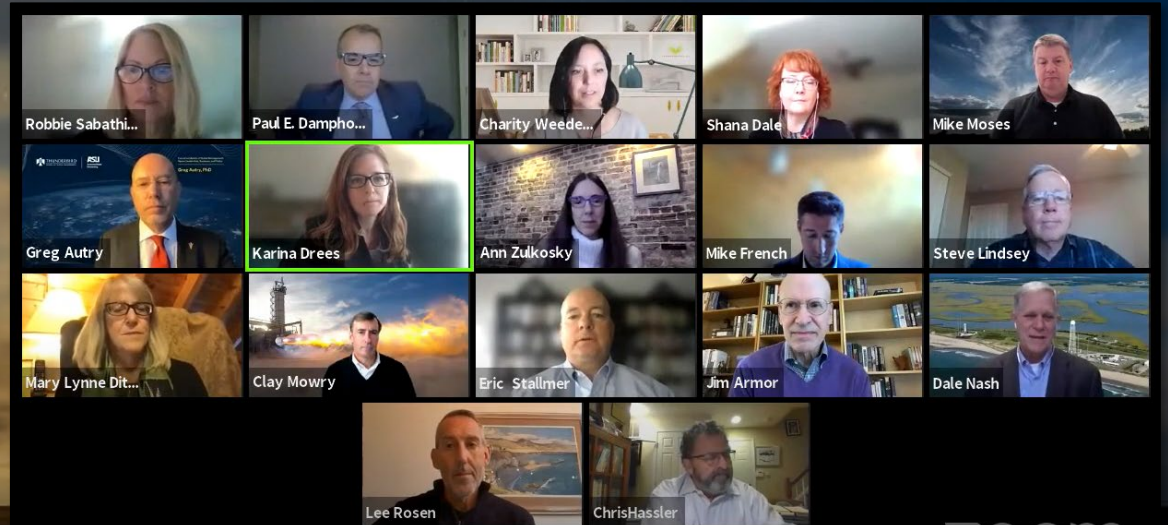




Spring 2020



Spring 2021



Fall 2021

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Closing Remarks for Day 1

James Hatt



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